Syllabus from the academic year 2020-2021

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
ENGINEERINGCHEMISTRY
(For ECE & EEE branches)

Instruction : 3 +1 Hrs / week	Semester End Exam Marks : 60	Subject Reference Code : U20BS010CH
Credits : 4	Continuous Internal Exam Marks : 40	Duration of semester End Exam : 3H

LEARNING OUTCOMES
At the end of the course, students should be able to:
1. Construct a galvanic cell and calculate its EMF and pH wherever applicable. 2. Describe the construction, functioning and applications of the selected primary, secondary batteries and fuel cells. 3. Catagorise the polymers and discuss the synthesis of a few polymers and their applications. 4. Get expose to basic concepts of engineering materials such as Composites and membranes. 5. Know the classification, properties, applications and types of liquid crystals & nano materials along with their synthesis.

UNIT-I: ELECTROCHEMISTRY (11)

Introduction, conductance, types of conductance- specific, equivalent, molar conductance and their interrelationship- numericals. Ionic mobility and transport number- definition, determination by Hittorfs method (Non attackable electrodes) numericals. Principle and applications of conductometric titrations- strong acid *vs* strong base, week acid *vs* strong base and mixture of acids *vs* strong base.

Cells- electrolytic and electrochemical cells. IUPAC convention of cell notation, cell reaction, concept of electrode potential, electro motive force (EMF). Electrochemical series – applications, Nernst equation-derivation, applications and numericals. Types of electrodes- construction and working of calomel electrode (CE), quinhydrone electrode and glass electrode (GE). Determination of pH using glass electrode and quinhydrone electrode. Applications of potentiometry- acid base and redox titration (Fe(II) Vs $KMnO_4$).

UNIT-II: BATTERY TECHNOLOGY (9)

Introduction- definition of cell and battery – Types of cells (reversible and irreversible cells). Battery characteristics: free energy change, electromotive force of battery, power density, energy density- numericals.
Primary, secondary and fuel cells.
Primary batteries: Construction and electrochemistry of Ag_2O-Zn battery and lithium-V_2O_5 battery.
Secondary batteries: Construction and working of lead-acid, Ni-Cd and lithium ion battery – advantages, limitations and applications.

Fuel cells: Concept, types of fuel cells and merits. Construction, working and applications of methanol-oxygen and phosphoric acid fuel cell.

UNIT-III: POLYMER CHEMISTRY (11)

Introduction, degree of polymerization, functionality of monomers and its effect on the structure of polymers. Classification of polymers-a) homo and co-polymers, b) homo chain and hetero chain polymers. c) plastics, elastomers, fibers and resins.
Types of Polymerization - Addition and condensation polymerization.
Glass transition temperature (Tg), factors affecting Tg.
Molecular weight- number average and weight average molecular weight, numericals.
Plastics: Thermo plastics and thermosets - preparation, properties and applications of a) Aramid (Kevlar) b) Phenol-formaldehyde (Bakelite) c) PVC
Elastomers: Natural rubber- structure – chemistry of vulcanization and advantages.
Artificial rubbers: Preparation, properties and uses of Buna-S and silicone rubbers.
Biodegradable polymers: Concept, preparation and uses of ploy lactic acid.
Conducting polymers: Definition- classification, mechanism of conduction in polyacetylene and applications.

UNIT-IV: ENGINEERING MATERIALS (9)

a. Composite materials:

Introduction, constituents of composites, advantages over conventional materials. Applications of composites. Types of composites based on matrix and dispersed phases. Manufacturing techniques – Hand lay up method-RTM, pull trusion methods.

Fiber reinforced composites: glass, carbon and aramid reinforced composites. Layered composites-applications.

b. Membrane technology

Introduction, classification- symmetric, asymmetric, electrically charged and liquid membranes. Working principle of membrane, advantages of membrane separation over conventional separation. Casting methods: phase inversion and solvent evaporation methods, synthesis of polyphenyleneoxide, polyethersulphone and membrane casting. Industrial applications of membranes- gas separation, pervaporation, elecetrodialysis, reverse osmosis, micro, ultra and nano filtration.

UNIT-V: ADVANCED ENGINEERING MATERIALS (10)

a. Nano Materials

Introduction - concept of nanomaterials - quantum confinement and surface volume ratio - catalytic property and mechanical properties.

Types of Nanomaterials**: c**arbon nano tubes**,** quantum dots, nanowires, nano crystals.

Synthesis of nano materials: top down and bottom up approaches**-** mechanical grinding by ball milling, sol gel method.

Carbon Nanotubes**:**single walled carbon nanotubes (SWCNTs). Multi walled carbon nanotubes (MWCNTs), synthesis of CNTs- arc discharge and laser ablation methods, applications.

b. Liquid Crystals

Introduction, classification of liquid crystals-Thermotropic and Lyotropic liquid crystals - Chemical constitution & liquid crystalline behavior. Molecular ordering in liquid crystals- Nematic, Smectic and Cholestric liquid crystals - Applications.

Text Books:

1. PC Jain, M Jain Engineering Chemistry, Dhanapathi Rai and sons (16th edition), New Delhi.
2. Sashi Chawla, Text book of Engineering Chemistry, Dhanapathi Rai &sons, New Delhi.
3. O.G. PALANNA, Engineering Chemistry, TMH Edition.
4. Wiley Engineering chemistry, Wiley India pvt Ltd, II edition.
5 . Chemistry in engineering and technology by J.C. Kuriacose and Rajaram.

Learning Resources:

1. University chemistry, by B. H. Mahan
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins
4. S. S. Dara, S Chand and sons, Engineering Chemistry, New Delhi.
5. Puri, Sharma and Pathania Principles of physical chemistry, Vishal Publishing Co.
6. NPTEL Polymer Chemistry Course, D. Dhara, IIT Kharagpur.
7. Polymer chemistry by Gowariker
8. Introduction to Nano science, by S m Lindsay, Oxford University press

Syllabus from the academic year 2020-2021

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
MATERIAL CHEMISTRY
(For CSE, CSE (AI & ML) and IT branches)

Instruction : 3 Hrs / week	Semester End Exam Marks : 60	Subject Reference Code : U20BS020CH
Credits : 3	Continuous Internal Exam Marks : 40	Duration of semester End Exam : 3H

LEARNING OUTCOMES
At the end of the course, students should be able to:
1. Construct a galvanic cell and calculate its EMF and pH wherever applicable.
2. Describe the construction, chemistry and applications of the selected primary, secondary batteries and fuel cells.
3. Categorise the macro molecules and discuss the synthesis of a few macro molecules and their applications.
4. Get expose to basic concepts of engineering materials such as Composites and liquid crystals.
5. Know the classification, synthesis, characterization, properties and applications of nanomaterials.

UNIT-I: ELECTRODICS AND ITS APPLICATIONS (9)

Introduction, conductance, types of conductance- specific, equivalent, molar conductance and their interrelationship-numericals. Principle and applications of conductometric titrations- strong acid *vs* strong base, weak acid *vs* strong base and mixture of acids *vs* strong base.

Concept of electrode potential, Helmholtz electrical double layer theory, electro motive force (EMF). Electrochemical series – applications. Nernst equation-derivation, applications and numericals. Concentration cells- numericals.

Types of electrodes- construction and working of calomel electrode (CE), quinhydrone electrode and glass electrode (GE). Determination of pH using glass electrode and quinhydrone electrode. Applications of potentiometry- acid base and redox titration (Fe(II) Vs $KMnO_4$).

UNIT-II: CHEMISTRY OF BATTERIES (9)

Introduction- definition of cell and battery – Types of cells (reversible and irreversible cells). Battery characteristics: free energy change, electromotive force of battery, power density, energy density- numericals.
Primary batteries, secondary batteries, and fuel cells.
Primary batteries: Types-acidic, alkaline and reserve batteries. Construction and electrochemistry of Zn-C, Ag_2O-Zn battery and lithium-V_2O_5 battery.
Secondary batteries: Construction and working of lead-acid, Ni-metal hydride, and lithium ion battery – advantages, limitations and applications.

Fuel cells: Concept, types of fuel cells and merits. Construction, working and applications of methanol-oxygen, phosphoric acid fuel cell and molten carbonate fuel cell.

UNIT-III: MACRO MOLECULES (9)

Introduction, degree of polymerization, functionality of monomers and its effect on the structure of polymers. Classification of polymers-a) homo and co-polymers, b) homo chain and hetero chain polymers. c) plastics, elastomers, fibers and resins.

Types of Polymerization - Addition and condensation polymerization.
Glass transition temperature (Tg), factors affecting Tg.
Molecular weight- number average and weight average molecular weight, numericals.

Plastics: Thermo plastics and thermosets - preparation, properties and applications of a) Aramid (Kevlar) b) Phenol-formaldehyde (Bakelite) c) Poly carbonate
Elastomers: Natural rubber- structure – chemistry of vulcanization and its advantages.
Artificial rubbers: Preparation, properties & uses of Buna-S and neoprene.
Biodegradable polymers: Concept, preparation and uses of ploy lactic acid.
Conducting polymers: Definition- classification, mechanism of conduction in polyacetylene and applications.

UNIT-IV: ENGINEERING MATERIALS (7)

a. Composite materials:

Introduction, constituents of composites, advantages over conventional materials. Applications of composites. Types of composites based on matrix and dispersed phases. Fiber reinforced composites: glass, carbon and aramid reinforced composites. Layered composites- applications. Manufacturing techniques – Hand layup, Resin transfer, pulltrusion and filament winding methods.

b. Liquid Crystals

Introduction, classification of liquid crystals-Thermotropic and Lyotropic liquid crystals - Chemical constitution and liquid crystalline behavior. Molecular ordering in liquid crystals- Nematic, Smectic and Cholesteric liquid crystals - Applications.

UNIT-V: NANOMATERIALS (8)

Introduction - Concept of nanomaterials - quantum confinement and surface volume ratio.
Properties of nanomaterials: Catalytic, electrical, mechanical and optical properties.
Types of Nanomaterials: Zero dimensional (0-D), One dimensional (1-D),Two dimensional (2-D),Three Dimensional(3-D).
Characterization of nanomaterials- Principle and block diagram of Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM).
Synthesis of nanomaterials: Top down and bottom up approaches- mechanical grinding by ball milling and sol -gel method.
Graphene: Introduction, synthesis of graphene by chemical vapor deposition (CVD).
Carbon Nanotubes: Classification - single walled carbon nanotubes (SWCNTs- armchair, zig-zag, chiral) and Multi walled carbon nanotubes (MWCNTs- Russian doll and parchment model).
Synthesis of CNTs- Arc discharge and laser ablation methods- applications of CNTs.

Text Books:

1. PC Jain, M Jain Engineering Chemistry, Dhanapathi Rai and sons (16th edition), New Delhi.
2. Sashi Chawla, Text book of Engineering Chemistry, Dhanapathi Rai &sons, New Delhi.
3. O.G. PALANNA, Engineering Chemistry, TMH Edition.
4. Wiley Engineering chemistry, Wiley India pvt Ltd, II edition.
5 .Chemistry in engineering and technology by J.C. Kuriacose and Rajaram.
6. The chemistry of nano materials-Synthesis, Properties and Applications by C N Rao, Wiley India pvt Ltd.

Learning Resources:

1. University chemistry, by B. H. Mahan
2. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
3. Physical Chemistry, by P. W. Atkins
4. S. S. Dara, S Chand and sons, Engineering Chemistry, New Delhi.
5. Puri, Sharma and Pathania Principles of physical chemistry, Vishal Publishing Co.
6. NPTEL Polymer Chemistry Course, D. Dhara, IIT Kharagpur.
7. Polymer chemistry by Gowariker
8. Introduction to Nanoscience, by S m Lindsay, Oxford University press

Syllabus from the academic year 2020-2021

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
APPLIED CHEMISTRY
(For Civil & Mechanical branches)

Instruction : 3+1Hrs / week	Semester End Exam Marks : 60	Subject Reference Code : U20BS020CH
Credits : 4	Continuous Internal Exam Marks: 40	Duration of semester End Exam: 3 Hours

LEARNING OUTCOMES

At the end of the course students should be able to:

1. Construct a galvanic cell and calculate its EMF and pH wherever applicable.
2. Describe the construction, functioning and applications of the selected primary, secondary batteries and fuel cells.
3. Catagorise the polymers and discuss the synthesis of a few polymers and their applications.
4. Rate the fuels and suggest methods for enhancement of the quality of fuels for the required output and explain the methods of preparation and applications of high energy materials namely Lead azide, TNT, Nitro glycerine and RDX.
5. Suggest appropriate treatment methods of water to make it fit for domestic and industrial applications and apply the principle of phase rule to heterogeneous equilibria.

UNIT-I: ELECTROCHEMISTRY (11)

Introduction, conductance, types of conductance- specific, equivalent, molar conductance and their interrelationship- numericals. Ionic mobility and transport number- definition, determination by Hittorfs method (Non attackable electrodes) numericals. Principle and applications of conductometric titrations- strong acid *vs* strong base, week acid *vs* strong base and mixture of acids *vs* strong base.

Cells- electrolytic and electrochemical cells. IUPAC convention of cell notation, cell reaction, concept of electrode potential, electro motive force (EMF). Electrochemical series – applications, Nernst equation-derivation, applications and numericals. Types of electrodes- construction and working of calomel electrode (CE), quinhydrone electrode and glass electrode (GE). Determination of pH using glass electrode and quinhydrone electrode. Applications of potentiometry- acid base and redox titration (Fe(II) Vs $KMnO_4$).

UNIT-II: BATTERY TECHNOLOGY (9)

Introduction- definition of cell and battery – Types of cells (reversible and irreversible cells). Battery characteristics: free energy change, electromotive force of battery, power density, energy density- numericals.
Primary, secondary and fuel cells.
Primary batteries: Construction and electrochemistry of Ag_2O-Zn battery and lithium-V_2O_5 battery.
Secondary batteries: Construction and working of lead-acid, Ni-Cd and lithium ion battery – advantages, limitations and applications.

Fuel cells: Concept, types of fuel cells and merits. Construction, working and applications of methanol-oxygen and phosphoric acid fuel cell.

UNIT-III: POLYMER CHEMISTRY (11)

Introduction, degree of polymerization, functionality of monomers and its effect on the structure of polymers. Classification of polymers-a) homo and co-polymers b) homo chain and hetero chain polymers. c) plastics, elastomers, fibers and resins.
Types of Polymerization - Addition and condensation polymerization.
Glass transition temperature (Tg), factors affecting Tg.
Molecular weight- number average and weight average molecular weight, numericals.
Plastics: Thermo plastics and thermosets - preparation, properties and applications of a) Aramid (Kevlar) b) Phenol-formaldehyde (Bakelite) c) PVC
Elastomers: Natural rubber- structure – chemistry of vulcanization and advantages.
Artificial rubbers: Preparation, properties and uses of Buna-S and silicone rubbers.
Biodegradable polymers: Concept, preparation and uses of ploy lactic acid.
Conducting polymers: Definition- classification, mechanism of conduction in polyacetylene and applications.

UNIT-IV-CHEMICAL FUELS AND HIGH ENERGY MATERIALS (10)

Fuels: Introduction, classification, requisites of a good fuel. Calorific value (CV)-HCV and LCV. Calculation of CV using Dulong's formula, numericals. Chemistry of combustion - numericals on volume- weight and weight-weight methods.
Solid Fuels: Coal: Proximate and ultimate analysis of coal and their significance.
Liquid Fuels: Fractions of crude oil, composition and CV of gasoline, cracking: Fixed bed catalytic cracking method. Knocking and its significance, octane number, enhancement of quality of gasoline by reforming and anti- knock agents. Leaded and unleaded petrol, power alcohol. Catalytic converters and their role in reducing the toxicity of automobile exhaust emissions. Composition and CV of diesel oil, cetane number.
Bio-diesel: Source, chemistry of transesterification, advantages of bio diesel.
Rocket Propellants- Principle of rocket propulsion, classification, characteristics of good propellants.
High energy materials- Introduction, classification, precautions during storage, characteristics of explosives (oxygen balance-numericals) preparation of lead azide, TNT, Nitro glycerine and RDX.

UNIT-V: WATER TECHNOLOGY AND PHASE RULE (9)

Hardness of water- types. Calculation of degree of hardness of water-numericals. Determination of hardness of water by EDTA method -numericals. Alkalinity of water and its determination-Numericals. Boiler troubles- scales and sludges formation and prevention-Calgonconditioning. Desalination of water by Reverse Osmosis. Specifications of potable water. Water treatment for drinking purpose sterilization by chlorination- concept of Break Point Chlorination.
Phase rule- explanation of terms involved, one component system: Water system, condensed phase rule, two component systems: Lead- Silver (Pb-Ag) system, Pattinson's process, Eutectics and their applications in safety fuses and solders.

Text Books:

1. PC Jain, M Jain Engineering Chemistry, Dhanapathi Rai and sons (16th edition), New Delhi.
2. Sashi Chawla, Text book of Engineering Chemistry, Dhanapathi Rai &sons, New Delhi.
3. O.G. PALANNA, Engineering Chemistry, TMH Edition.
4. Wiley Engineering chemistry, Wiley India pvt Ltd, II edition.
5. Chemistry in engineering and technology by J.C. Kuriacose and Rajaram.

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3. Physical Chemistry, by P. W. Atkins
4. S.S. Dara, S Chand and sons, Engineering Chemistry, New Delhi.
5. Puri, Sharma and Pathania Principles of physical chemistry, Vishal Publishing Co.
6. NPTEL Polymer Chemistry Course, D. Dhara, IIT Kharagpur.
7. Polymer chemistry by Gowariker

Syllabus from the academic year 2020-2021

VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS)
DEPARTMENT OF CHEMISTRY
CHEMISTRY LAB

Instruction : 2 Hrs / week	Semester End Exam Marks : 50	Subject Reference Code : U20BS011CH
Credits : 1	Continuous Internal Exam Marks : 30	Duration of semester End Exam : 3 Hours

LEARNING OUTCOMES:
At the end of the course, students should be able to:
1. Determine the amount of metals in the given solutions. 2. Analyse the hardness, alkalinity and chloride content of a given water sample. 3. Estimate the amount of a substance in a given solution by conductometry, potentiometry and pH metry. 4. Use the principle of colorimetry in the estimation of Permanganate / Copper (II) in a given solution. 5. Synthesize a polymer.

1. Preparation of standard FAS or oxalic acid solution and standardization of $KMnO_4$ or NaOH solution.
2. Estimation of ferrous iron in the given solution by permanganometry.
3. Estimationof chromium in the given solution by standardized FAS.
4. Estimation of copper in brass or given solution by hypo.
5. Estimationof available chlorine in bleaching powder.
6. Estimation of total hardness of given water sample.
7. Estimation of alkalinity of a given sample.
8. Conductometric acid-base titrations -Determination of strength of given acids (HCl *Vs* NaOH and CH_3COOH *Vs* NaOH).
9. Conductometric acid-base titrations- Determination of strength of acids in a given mixture of acids (HCl and CH_3COOH *Vs* NaOH)
10. Determination of strength of a given acid by Potentiometry.
11. Determination of concentration of a given $FeSO_4$ using redox titration by Potentiometry.
12. Determination of strength of a given acid by pH metry.
13. Determination of strength of permanganate or copper in brass solution by Colorimetry.
14. Determination of concentration of a salt by ion exchange method.
15. Synthesis of Aspirin or Phenol formaldehyde resin.

Text Books:

1. G H Jeffery, J Bassett, J Mendham, R C Denney, Vogel's text book of quantitative chemical analysis, Fifth Edition.
2. M S Kaurav, Engineering chemistry with laboratory experiments, PHI learning (P) ltd, New Delhi.
3. Sunita rattan, Experimenta in applied chemistry, S K Kataria & Sons (2010)
4. A text book on experiments and calculation Engg. S.S. Dara.

Syllabus from the academic year 2020-2021

VASAVI COLLEGE OF ENGINEERING (A)
DEPARTMENT OF CHEMISTRY
B E III Semester
Open Elective: BATTERY SCIENCE AND TECHNOLOGY

Instruction : 2Hrs / Week	Semester End Exam Marks : 60	Subject Reference Code : U20OE310CH
Credits : 2	Continuous Internal Exam Marks : 40	Duration of semester End Exam : 3Hours

LEARNING OUTCOMES:
At the end of the course students should be able to:
1.Discuss the construction, electrochemistry, technology and applications of selected primary batteries
2.Discuss the construction, electrochemistry, technology and applications of few secondary batteries
3.Explain the working principle, electrochemistry, technology and applications of prominent fuel cells
4. Evaluate different batteries or fuel cells in order to select a suitable battery or fuel cell for a given application

UNIT-I: BATTERIES- FUNDAMENTALS

Introduction and types of batteries: Primary and secondary.
Battery characteristics: Free energy change, electromotive force of battery, ampere-hour, capacity, power, power density, energy density, efficiency, cycle life, tolerance to service conditions, performance characteristics.

UNIT-II: PRIMARY BATTERIES

Construction, chemistry and technology of Zinc-Air Battery, Zinc –HgO battery and their applications.
Primary lithium batteries: Soluble cathode cells, solid cathode cells- Lithium manganese dioxide, solid electrolyte cells- Lithium polymer electrolyte battery- Applications. Reserve battery- Electrochemistry of perchloric acid cell- applications.

UNIT-III: SECONDARY BATTERIES

Construction, chemistry and technology of maintenance free lead acid battery (MFLA), valve regulated lead acid battery (VRLA), absorbed glass mat lead acid battery (AGMLA) - comparision between lead acid battery and VRLA along with advantages - Construction, electro chemistry and applications of Nickel-Cadmium battery, Nickel metalhydride battery.
Lithium ion batteries: Construction, chemistry and applications of liquid organic electrolyte cells, polymer electrolyte cells, lithium ion cells.

UNIT- IV: FUEL CELLS

Introduction, classification based on temperature and nature of electrolyte. Working principle, components, applications and environmental aspects of alkaline fuel cell (AFC)- Hydrogen-Oxygen alkaline fuel cell, Molten carbonate fuel cell (MCFC), Polymer electrolyte membrane fuel cell (PEMFC), Solid oxide fuel cell (SOFC).

Books:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai and Pub, Co., New Delhi (2002)
2. S.S. Dara "A text book of engineering chemistry" S.Chand and Co.Ltd., New Delhi (2006).
3. Dell R. M. and Rand D. A. J., "Understanding Batteries", Royal Society of Chemistry, UK, 2001.
4. Chemistry of Engineering Meterials by R.P Mani and K.N.Mishra, CENGAGE learning
5. Shasi Chawla, "Text Book of Engineering Chemistry", Dhanpat Rai Publishing Company, NewDelhi,2008.

Suggested Reading:

1. Dell R. M. and Rand D. A. J., "Understanding Batteries", Royal Society of Chemistry, UK, 2001.
2. Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Chapman and Hall, New York, 1993.